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# Completing a Successful Migration

# Porting from 32 to 64 Bit: Step-by-step

- **Decision making/planning**
  - In some cases 32 bit is all you need !
- **Porting strategy**
  - Port everything ?
  - Integrate 32-bit components by IPC
- **Identify dependencies**
  - Are your tools, libraries, drivers all ported?
  - Do you have the required operating system, hardware?
  - Linux 32 versus Linux 64 differences
- **64bit Code Clean**
  - Use the compiler to help in 64-bit porting ( -wp64 )
  - ANSI-compliant coding
  - One source base only
  - Use pre-processor definition where really necessary
- **Fix potential run-time issues**
  - Debugging
  - Memory alignment
- **Optimization**
  - Use tools like Intel<sup>®</sup> Vtune<sup>™</sup> to optimize for target architecture

# Defining a Successful Ported Application

- Application runs on the new platform
- One source code base only
- Third-Party dependencies will be supported for new platform too in the future
- Application performs well on the new platform
- Application is sold on the new platform

# Key to a Successful Migration Start

- **PLANNING!**
- Product experts need to be involved
- Allow time for testing
- Allow time to learn new tools
- Do forget to plan to migrate any build environment/tools
- Third party requirements
- Know the environment and requirements BEFORE you start
- Allow time to update documentation
- Aren't 32 bit enough for your application ?

# Sometimes 32-bits is Enough!

- Minimize work by leaving some apps 32-bits:
  - Text editors
  - Line-Drawing “Drafting” applications
  - Many compiler-like apps

Useful Rule-of-Thumb: 1.5 “bits” of capacity per year

1. Measure your largest data space’ (file size, in-memory data, net transmission, etc.) capacity
2. Multiply by  $1.5^{10}$  ( $\approx 58$ )

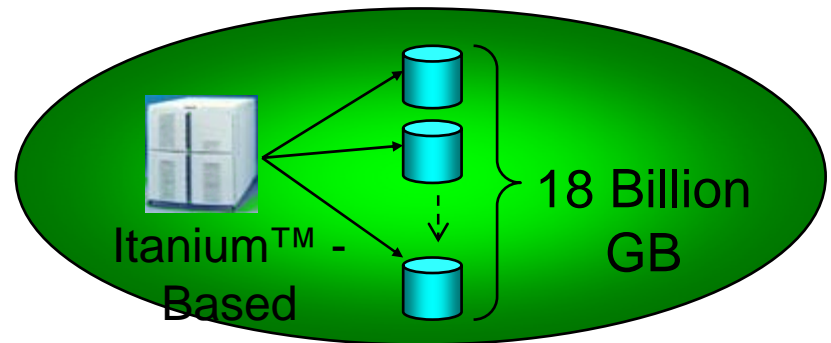
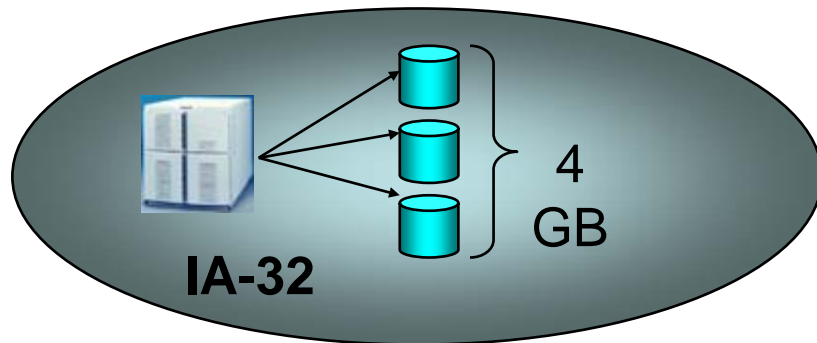
If the result is *still*  $\leq 2^{32}$ , the app can stay 32 bits

- native, fast Itanium<sup>®</sup> instructions ( currently only HP-UX )
- as competitive, already-built x86 binaries
  - But then performance still might make a move to 64bit useful !

Do you *really* need a 64-bit editor ?

# 64-bit Address Space

- Benefit from 64-bit addressing
  - Virtual address space of  $2^{64}$  bytes
    - For server & database applications
    - For huge data-set manipulation code



The physical address space is smaller : 50 Bits on Itanium® 2 Processor

The operating system might limit (virtual) size of memory segments to something less than  $2^{64}$

# However we live in a REAL world ...

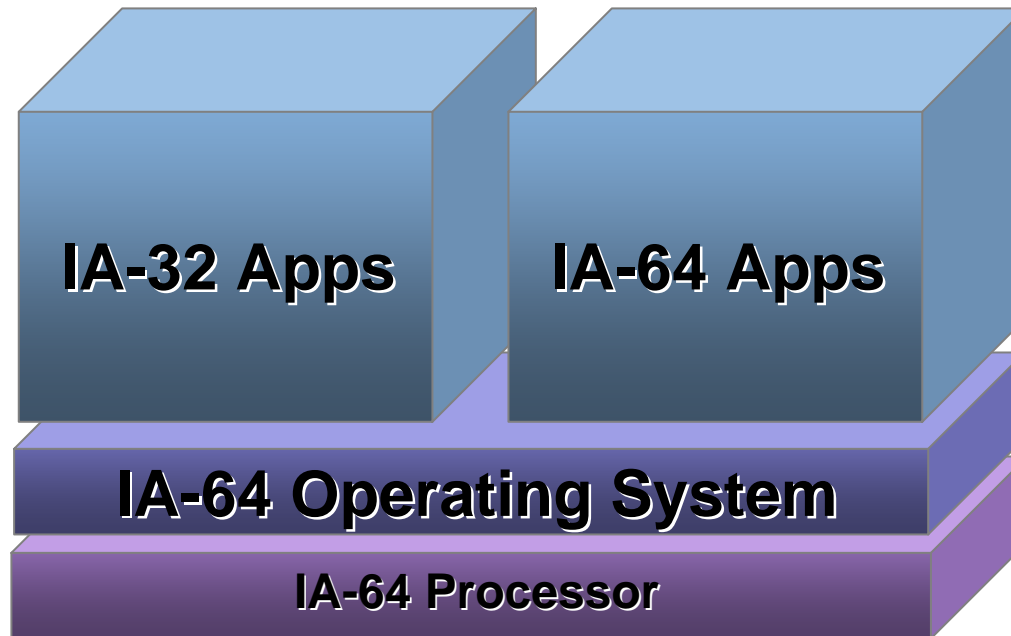
- The physical address space is smaller
  - $2^{52}$  for Itanium<sup>®</sup> 2 Processor
  - Much larger than on x86-64 systems ( typically  $2^{36}$  up to  $2^{40}$  )
- The Itanium<sup>®</sup> system in the market today have lower limits again for physical amount of memory
  - Typically  $\geq 2^{36}$
  - But big enough for huge ( 512/1024/ ... processor) Itanium<sup>®</sup> 2 SMP systems
- The operating system might define further limits ...

# Limits of SUSE Linux Enterprise Server 9, kernel version (version 2.6.5-7)

Platform	x86	Intel® Itanium® Processor Family	X86-x64 ( Intel EM64T / AMD x64)	IBM® S/390® (31 bit)	IBM® zSeries®	IBM® POWER™
<i>Kernel related items</i>						
CPU bits	32	64	64	32	64	64
max. #CPUs (practical)	4-32	4-512	8	16	32	64
max. #CPUs (theoretical)	128	512	8	32	64	32 (iSeries), 128 (pSeries)
max. user-/kernel space	3 GB	2 EB ( full 64 bits)	512 GB	2 GB	N/A	2 TB
max. RAM (practical)	48 GB	4 TB	512 GB	2 GB	256 GB	512 GB
max. RAM (theoretical, practical)	64 GB	1 PB	1 TB	2 GB	4 TB	1 PB
max. swap space	up to 32 * 64 GB					



# 32 Bit Compatibility in Architecture

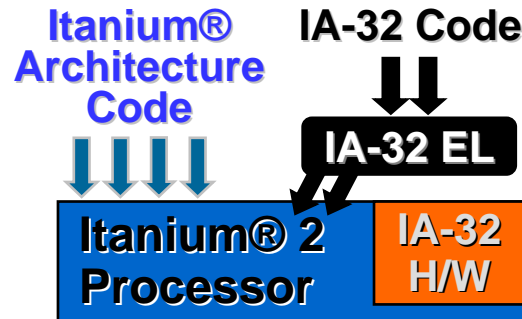


- **Full compatibility with the x86/87 instruction set**
- **Includes SSE-1 and Intel® MMX™ Technology instructions**
- **IA-32 supported in processor hardware**
- **Support for inter- & intra-proc. Itanium® / IA-32 transitions**

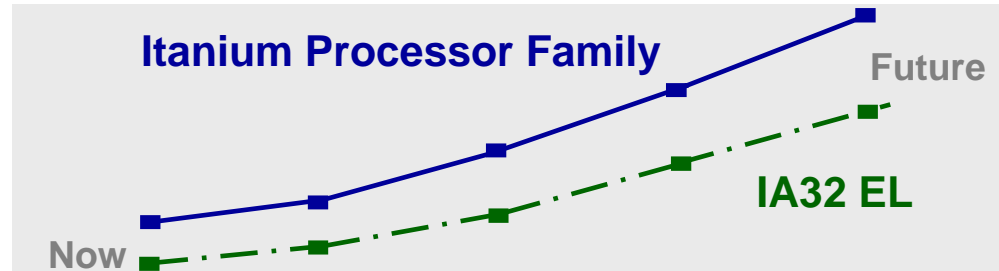
# IA-32 Execution Layer

- IA-32 Execution Layer (EL-32) supports IA-32 applications running on Itanium<sup>®</sup> 2-based systems by software emulation

## IA-32 EL Is an Advancement Over IA-32 On-die Hardware



## IA-32 EL Performance Scales with Future Itanium<sup>®</sup> Processors<sup>1</sup>



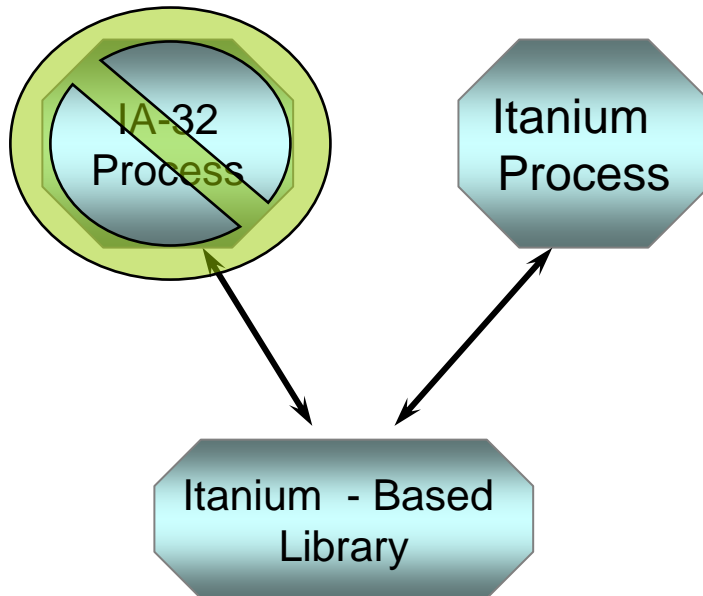
<sup>1</sup> Data extrapolated from measurements using frequency scaling and assuming incremental optimization. All products, dates, and figures are preliminary and are subject to change without notice.

- Supports Instructions Set extensions ( SSE-2, SSE-3 )
- Approach similar to Java JIT ( Just-In-Time compilation )
- Availability
  - Microsoft Windows 2003 Server, SP1 or as a separate download package
  - SUSE SLES 8.x, Redhat 3, 4
- Performance
  - Estimate 32-bit application performance on Itanium 2 processor 1.5 GHz, 6 MB similar to Xeon<sup>™</sup> processor MP 1.5GHz (performance varies by application)
  - Delivers ~ 50% to 70% of native Itanium architecture performance

# Combining 32Bit and 64Bit Code

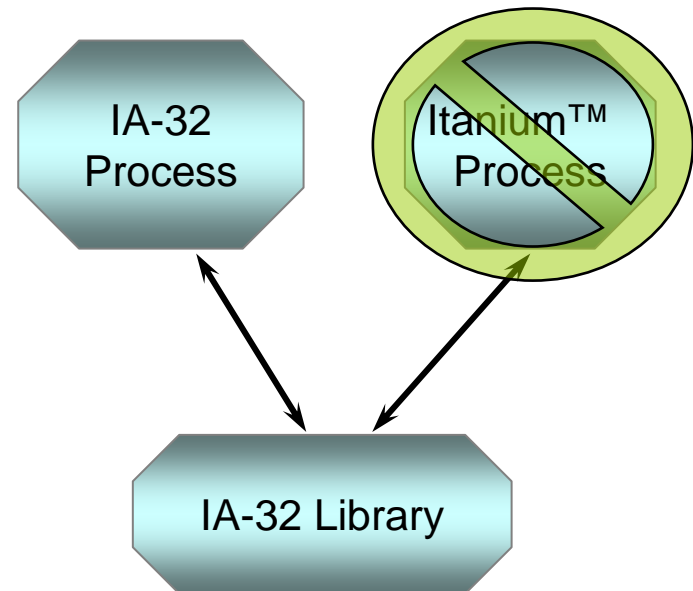
## ● Itanium library port

- The library can only be used by Itanium apps.



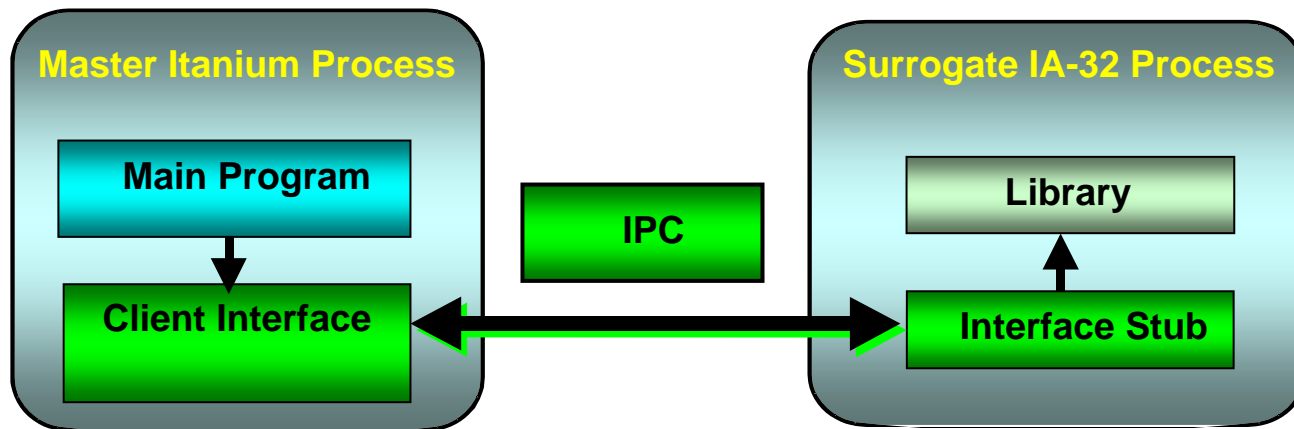
## ● IA-32 library

- The library can only be used by IA-32 apps.
- OS does not allow mixing of IA-32 and Itanium<sup>™</sup> instructions.



# Combining 32Bit and 64Bit Code

- 32-bit library access to 64-bit process through IPC/RPC/Shared memory objects
  - Surrogate binaries can be used to manage the IPC translation with no changes to existing code



\* Third party names and brands are the property of their respective owners

# Byte Order Issues

- Endianism
  - Several UNIX legacy platforms are big-endian
  - Most Linux platforms are little-endian
    - Itanium HW can support both however
  - Use named bit fields and unions/structs
  - Check all networking code
    - Use host-to-network family of routines, i.e. htons()

int32\_t i = 1025

## Little Endian

char\*[0] = 0x01

char\*[1] = 0x04

char\*[2] = 0x00

char\*[3] = 0x00

## Big Endian

char\*[0] = 0x00

char\*[1] = 0x00

char\*[2] = 0x04

char\*[3] = 0x01

# Identification of Dependencies

- Make a detailed list of what you really need
  - OS
  - Tools
  - DLLs
  - Drivers
- Intel works/ed with hundreds of ISVs to get application migrated to Itanium<sup>®</sup> Architecture
  - Check with ISV on availability
  - Intel contact may be able to help
  - Intel has programs to enable ISVs in all GEOs
- Intel and OEMs might be able to loan development HW

# Middleware for Itanium® Architecture

- Java
  - Not different from IA32 ( no data type size dependence)
  - But look at JNI calls
  - Recommended JVM: BEA JRockit
    - Latest version: 5.0 R26 available for Itanium
    - In-depth tuned for Itanium® architecture
- MONO / .NET alternative
  - Available for Itanium® Linux too

# Broad Ecosystem Support

## Application Choice



- >5500 native applications
- 32-bit application support with IA-32 Execution Layer

## Operating System Choice



- Windows\*, Linux\*, Unix\*, & VMS support

## System Vendor Choice



- Broad selection from top global & regional OEMs
- 2-way to 512-way systems
- >15 large SMP systems

\*Other names and brands may be claimed as the property of others.



## Industry Leaders Spearhead New Itanium<sup>®</sup> Solutions Alliance



## Services to Help Migrate

- “Standardized” Linux – the Linux Standard Base (LSB) [www.linuxbase.org](http://www.linuxbase.org)
- Developer Resources
  - HP: [www.hp.com/go/linuxdev](http://www.hp.com/go/linuxdev)
  - Intel: [www.intel.com/software](http://www.intel.com/software)
  - Red Hat: [www.redhat.com/developer](http://www.redhat.com/developer)
  - Novell: [developer.novell.com/linux](http://developer.novell.com/linux)

# Resources

- “Solaris to Linux Porting Guide” – [www.hp.com/go/LinuxDev](http://www.hp.com/go/LinuxDev)
- Solaris to Linux Porting Kit – [www.hp.com/go/STK](http://www.hp.com/go/STK)
- [devresource.hp.com/linux](http://devresource.hp.com/linux) – developer discussion forums
- “Itanium Architecture for Software Developers”, Philip Ezolt
  - [www.intel.com/intelpress](http://www.intel.com/intelpress): ISBN 0-97-028464-0
- “Optimizing Linux Performance”, Walter Triebel
  - [www.hp.com/hpbooks](http://www.hp.com/hpbooks): ISBN 0-13-148682-9

# Summary

- Plan and prepare your migration to Itanium<sup>®</sup> Architecture
- The “Code Clean” part can be most time consuming
- For your source code, 64Bit Itanium<sup>®</sup> is not really different from 64bit x86-64 architecture
- Tuning, documentation and availability of developer tools might make porting to Itanium even much easier than for other 64bit architectures
- Intel, OEMs and OSVs offer a lot of resources and support to make migration a smooth process

# Questions?

